Implementing Project Based Survey Research Skills to Grade Six ELP Students with *The Survey Toolkit* and *TinkerPlots*®

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Abstract

Survey Toolkit Collecting Information, Analyzing Data and Writing Reports (Walsh, 2009a) is discussed as a survey research curriculum used by the author's sixth grade students. The report describes the implementation of *The Survey Toolkit* curriculum and *TinkerPlots*® software to provide instruction to students learning a project based research methodology using surveys for the last six years. The article presents classroom instructional strategies to more effectively deliver the curriculum, along with examples of student work. Research supporting the teaching of statistics across the curriculum, implementation considerations, and an introduction of the development and organization of *The Survey Toolkit* is provided. Use of the curriculum with students focusing on findings from their selected sample, cognizant of inferential research methods (e.g., hypothesis testing) and not being able to generalize findings to a population is discussed. A piloted formal assessment and rubric evaluation of completed survey projects provides evidence of the learning skills and competencies students acquire using the curriculum model. The need for further research to evaluate the effectiveness of the curriculum materials, student learning, and staff development is discussed.

1. Introduction

The Survey Toolkit is a survey research curriculum that has been developed and used by the author's sixth grade students who have been identified as academically high achieving in mathematics. These students are eligible to receive services in the district Extended Learning

Program (ELP). ELP extends and differentiates the existing grade level curriculum to provide a more challenging and rigorous learning experience for students. *The Survey Toolkit* curriculum and *TinkerPlots*® software have been used by the author to provide instruction to students in learning about survey and statistics for the last four years, resulting in a final published text by Key Curriculum Press. A literature review will be presented providing support for statistics literacy for all students in addition to teaching data analysis across the curriculum. The article will discuss teaching strategies to effectively implement the curriculum and present examples of student work. Permission has been granted by the school district along with students and parents for collecting the work samples. Information about the development and organization of *The Survey Toolkit* will be provided. Learning skills students acquire using the curriculum based on rubric evaluation of completed survey poster board projects and post assessment, will also be presented. Student selection of a sample to administer their surveys, which are not inferential in nature limiting their ability to generalize findings to the population, is discussed. Finally, the need for further research to evaluate the effectiveness of these curriculum materials, student learning, and staff development is presented.

2. Support for a Statistics Curriculum and Implementation

The support for providing an introduction to a statistics curriculum at all ages is evident based on the widespread use of statistics in our life. The ability to collect, organize, describe, display, and interpret data, as well to make decisions and predictions on the basis of that information, is a skill that is increasingly important in a society based on technology and communication. The study of statistics provides students with the tools and ideas to use in order to react intelligently to quantitative information in the world around them (Garfield & Ben-Zvi, 2007). The National Council of Teacher of Mathematics (NCTM) Standards (2000) report that the use of statistics in everyday life is staggering, found in consumer surveys that guide the development and marketing of products, polls helping to determine political-campaign strategies, and experiments used to evaluate the safety and efficacy of new medical treatments. NCTM believes that students need to understand probability and statistics to become informed citizens and intelligent consumers.

Given the need for statistics literacy at all levels and current widespread use, support for teaching this curriculum is now endorsed by a number of professional organizations. The National Council of Teacher of Mathematics (NCTM 2000) Data Analysis and Probability Standards report recommends that instructional programs for all students include data and statistical methods for grades six to eight. The report supports work in data analysis and probability in offering a natural way for students to connect mathematics with other school subjects and with everyday experiences. The American Statistical Association (ASA) in conjunction with NCTM for years has supported the introduction of more exploratory data analysis and elementary statistics into the school curricula.

Insight into the delivery model for teaching a statistics curriculum is also provided. NCTM and other organizations including the American Association for the Advancement of Science Report and Science for All Americans for quantitative literacy using authentic data driven activities, have suggested that one way to help students value statistics may be to embed statistics within other disciplines (Garfield & Ahlgren, 1988; Rutherford & Ahlgren, 1990). Batanero, Burrill, & Reading (2006, pp. 3-4) state "Statistics is much more closely related than mathematics to other

sciences (from linguistics or geography to physics, engineering or economy) where it is used as the language and method of scientific enquiry and from which many statistical methods were developed." Starkings (1993) suggests that issues relating to the teaching of data analysis are important to teachers of a wide range of subjects across the whole curriculum. In most educational establishments data analysis does not exist as a subject in its own right (Starkings, 1993). *The Survey Toolkit* program supports the idea of data analysis providing the opportunity to teach across the curriculum.

3. Development and Organizational Components of *The Survey Toolkit*

3.1. Development of *The Survey Toolkit*

The Survey Toolkit provides a research curriculum in which students use authentic survey data to answer research questions about a topic of interest. The curriculum methodology using the *TinkerPlots*® software follows the scientific method or procedures for collecting and organizing information in testing and analysis. Students create a database for entering survey data, and then make graphical plots to display findings. The graphs help to answer hypotheses and the students' research questions.

The development of the text is a result of the author's workshop training in the writing process, graduate course work in research and statistics, and field-testing text materials with his third and sixth grade classes. The curriculum development has been an ongoing process over a period of 20 years, leading up to more recent integration of the text materials with *TinkerPlots*® and revisions with editors at Key Curriculum Press.

The Survey Toolkit includes a curriculum for students to write a report by locating information about their research question or topic of study. Students write a report using an inquiry-based approach. This involves students' writing a paragraph by listing facts, categorizing the ideas to develop main ideas, and using facts for supporting details in paragraphs. Support for this approach is provided by Hillock's (1987) 20 years of research in the composing process and teaching methods for writing. Hillock reports writing methods should focus on inquiry or directing students' attention on strategies for transforming raw data along with the practice of building complex sentences from simpler ones. Joyce, Calhoun and Hopkins (1999) report that the modeling of writing devices or the presentation of good pieces of writing has the highest student benefit (effect size 0.57 standard deviations) from well-implemented "inquiry" approaches to the teaching of writing.

During the 1990's the Ames Community Schools were providing staff development activities to improve student math problem solving skills in accordance with The National Council of Teacher of Mathematics (NCTM) Standards. It was during this period that the inquiry approach and teaching strategies which foster student problem solving were provided through staff in-service activities. At this time interest developed in inquiry-based learning activities through teaching probability and statistics. In 1991 a survey guide booklet integrating the writing process for collecting research information was written and piloted with the author's third grade class.

After the original survey booklet was written, later versions were developed and rewritten, leading to *The Survey Toolkit* text. The earlier revisions of the text were made with third grade students. Written records were kept with revisions based on student feedback and use of the materials. The 1995 guide was field tested by a sixth grade teacher colleague with his students. This text resulted in a 1998 guide with improvements in the guide's layout, clarity of directions, and user friendliness. Bibliography cards used by the media specialist were reformatted and added to the research writing section to improve students' ability to accurately cite sources. Further revisions were made throughout the text after reviews by classroom teachers were completed in 2004. Other revisions were made including improvements in the teaching of statistical measures. In 2005, significant changes and additions, including integration of the *TinkerPlots*® software program, were made with editors at Key Curriculum Press. Numerous lesson and student activity page changes in the analysis of data using *TinkerPlots*® were made. Many of these changes were based on feedback and use of the text with the author's sixth grade ELP students. Additional editorial changes were made through Key Curriculum Press, including peer review of the text with three teachers from around the U.S. and one university faculty member. Editor revisions at Key Press were instrumental in rewriting, streamlining and organizing *The Survey Toolkit*. Editing and rewriting in the final revision stages greatly improved the text's readability, use, and integration with *TinkerPlots*®.

3.2. Organization Plan for *The Survey Toolkit*

The organizational plan for *The Survey Toolkit* was developed using the process for conducting research developed from the author's graduate study in research and statistics. The scientific method presented by Moore (1983) provided a sound framework to apply in developing the text's organizational plan. The scientific method is an appropriate instructional sequence in which students collect information (e.g., by text, digital media, or computer web-based), develop the survey, and then accurately present data results in the final summary report. The scientific method or procedure for collecting and organizing information for testing and analysis is as follows:

1. Recognize a problem
2. Define the problem in clear, specific language
3. Develop hypotheses
4. Develop techniques or instruments to obtain information related to the problem and hypotheses
5. Collect data or information
6. Analyze the data or information
7. Generate conclusions based upon data related to the hypotheses (Moore, 1983, p. 5).

The steps for planning a survey research project were incorporated into the text sequence and progression of lessons.

The Survey Toolkit lessons in the text were organized based on the scientific method and following a research methodology supported by Borg and Gall (1989). The lesson plans and activities to follow during the research process are presented in *The Survey Toolkit* table of contents and listed by lessons as follows:

Part 1. Choosing a Research Question
- 1.1 Introducing Surveys
- 1.2 Looking at Survey Data
- 1.3 Planning and Setting Goals
- 1.4 Finding Information
- 1.5 Summarizing Information

Part 2. Developing and Giving the Survey
- 2.1 Writing Survey Questions
- 2.2 Choosing a Sample
- 2.3 Writing a Hypothesis
- 2.4 Finishing and Giving the Survey

Part 3. Analyzing Survey Data
- 3.1 Representing Survey Responses
- 3.2 Entering Data into TinkerPlots
- 3.3 Exploring Categorical Attributes
- 3.4 Exploring Quantitative Attributes
- 3.5 Comparing Attributes

Part 4. Sharing Results
- 4.1 Writing Findings and Conclusions
- 4.2 Summarizing Your Research
- 4.3 Making a Poster or TinkerPlots Report
- 4.4 Writing a Report

These lessons constitute the research methodology students follow to successfully complete a survey project. Through individual and cooperative involvement in planning and completion of the research report, students obtain knowledge from library media sources and a sample of people. In addition, students acquire whole language and math experiences in which information is read from sources, survey items are written, results are graphically plotted with statistical displays, and findings are reported with conclusions and recommendations. During the process, students develop social and communication skills working in cooperative groups and sharing results orally to the class. Using the scientific research method, students gain an understanding of the procedures involved in conducting research. The survey research report is interdisciplinary, requiring students to work across the curriculum in developing research questions on a topic of interest, reading text, recording factual information, designing survey questions, analyzing data using *TinkerPlots*® graphs with statistical findings, evaluating hypotheses, writing results, and sharing findings with others in a written report or poster board.

3.3. *The Survey Toolkit Resource Manual* Supplemental Resource

Additional unpublished resources written by the author and used in his classroom were developed into *The Survey Toolkit Resource Manual*. The resources are available for use at the Journal of Statistics Education (JSE) website. Please click on the link below to download the 88 page *The Survey Toolkit Resource Manual.*

http://www.amstat.org/publications/jse/v19n1/SurveyToolkitResourceManual2011.pdf

The Survey Toolkit Resource Manual has been used with the author's students to support and provide background reading and activities for *The Survey Toolkit* text. The manual readings are integrated with *The Survey Toolkit* lesson plans showing lesson numbers identified after the chapter titles in the table of contents. The chapter readings in the manual have provided students with additional information about key concepts and vocabulary involved in conducting survey research. The readings have been helpful for students in developing understanding of concepts and vocabulary terms prior to introducing a lesson. The appendix resources have been used to provide a vocabulary dictionary for students to record terms presented in the lessons, which serve as a review prior to giving a pre- and post-assessment. Vocabulary pages for placement on

a word wall have also been displayed. Additional student activity pages to support instruction have been used to deliver the curriculum and include:

- The Factoid page for students to collect facts and record references when finding background information about their research questions, with a template page for writing a summary report paragraph.
- Survey templates for developing a questionnaire to support students in writing a variety of different types of question items.
- The *TinkerPlots*® Data Completion Checklist helpful for examining data in various ways to generate a variety of graphs related to the research questions and evaluating hypotheses.
- A peer review log for students to provide feedback about the completed survey research project poster board.
- Guidelines for entering attributes and values on *TinkerPlots*® data cards including use of text boxes.

While *The Survey Toolkit Resource Manual* and its development of activities have been used as a supplemental resource with students, it also includes an added staff development plan for *The Survey Toolkit* and *TinkerPlots*® teacher training. *The Survey Toolkit* and *TinkerPlots*® provide teachers the necessary resources to successfully delivery and teach the curriculum for the student research project. The manual includes additional activities and materials to support delivery of the curriculum.

4. Teaching Strategies Promoting Effective Use of *The Survey Toolkit*

Use of *The Survey Toolkit* text and *TinkerPlots*® program with sixth grade ELP students has been conducted during the last six years. During the first three years a draft version of the manuscript was used and revisions were made based on ideas shared with Key Press editorial staff and feedback from students on their survey research projects. The editorial changes lead to publication and use of the current text during the fourth year. A description of the students' and author's use of *The Survey Toolkit* and resource manual will be discussed focusing on its implementation, teaching methodology, and strategies to support effective delivery of the curriculum. The discussion will include samples of student work presented during the research project development.

4.1. Choosing a Research Question and Finding Information

In the introduction of the survey research project, it is helpful to discuss experiences students have had answering surveys and how these are different from taking a quiz or test. Students have been found to easily report ideas about how surveys can be used for research (e.g., census, politicians, and marketing a product).

In the first lesson, using teacher-facilitated discussion, it is necessary to help students understand that surveys are often not useful in finding answers about facts not related to people. This information can usually be found from a reliable source. These ideas will seem obvious to most students who will choose to write opinion-type survey questions. However, some students may want to find out how much their selected sample knows about the topic and prefer to include some factual "test type" survey questions. Another discussion point in the lesson will include

questions on a survey as opposed to those on research. For example, if a researcher wants to find out how much students are interested in learning about meteorology (research question) they may ask how often students watch the weather channel on television or online. Other discussion items in the lesson will include introducing the ideas of population, sample, and hypotheses leading to an activity for students to order the steps for conducting survey research. This activity provides students an overall plan and understanding of the research process. The project steps and *TinkerPlots*® lessons were designed based on the scientific method and research methodology by Borg and Gall (1989).

In the second lesson in *The Survey Toolkit*, students learn about analyzing data using the *TinkerPlots*® software, including Help resource movies (i.e., Basics movie) and the Data and Demos document on New Zealand students. The Data and Demos documents allow students to select and explore other databases included with the program involving creating graphs to answer questions. The databases introduce students to the concept of attributes (variables) with an activity page on role models graphed for evaluation.

After these preliminary lesson activities, students are ready to identify possible research questions of interests, develop survey questions ideas, and write a research goal statement. Some students will need support writing the research question to decide if their question could be answered by the research report (i.e., based on existing information) and/or from questions developed into a survey. Examples of student research questions are shown in Figure 1.

Figure 1. Examples of Research Questions Written by Sixth Grade ELP Students

- What do people think about solar energy?
- What do students think about life in ancient Rome and what is their opinion on how the government functioned?
- Do you have a likely chance of having a visual impairment if one or both of your parents do?
- How many people want to be a scientist when they grow up?
- What rocket would be best to explore deep space?
- What area in math do students like best?
- Is the average middle school student healthy and fit?
- What colors make people feel happy or nervous?
- How do different alternative fuels benefit the environment?
- Are their significant opinions on or about alternative fuels?
- What kind of volcano do people know most about?
- What choice of healthy foods are students choosing?
- What country in Western Europe do you want to visit the most?
- What do 6th grade students know about alternative fuels?

Since the students are provided services in an ELP program, research questions are focused to cover topics related to or integrated within the sixth grade curriculum. A handout of units of study covered in the sixth grade curriculum is provided to students for review. As a result, students developed research questions about the following topics shown in Table 1.

Table 1. Research Question Topic Ideas Selected by Middle School Students

Science and Technology	**History and World Cultures**
Aircraft	Ancient China
Aviation Progression	Ancient Egyptian Cultures
Alternative Fuels	Ancient Egyptian Gods and Goddesses
Astronomy	Ancient India
Constellations	Confucianism and Taoism
Flying Devices	Easter Island
Energy and Machines	Egyptian Mythology
Energy Sources (Forms)	Famous People of Medieval Times
"Green" Environment	Foods of the Renaissance
Hovercrafts and Segways	Greek Mythology (Gods)
Inventions	Greece
Light Reflection and Sound Waves	Han Dynasty
Math and What People Like About It	Hinduism
NASA: The Founding and Space Pilots	History of the Renaissance
Nanotechnology	Medieval Music
Natural Disasters	Medieval Period and Castles
Physics: Work, Energy and Power	Medieval Siege Weapons and Castle Defenses
Planets	Roman Infantry
Rockets	Rome
Simple Machines	Spartan's Weapons
Solar Energy	Travel Destinations
Space Exploration	Tudor Dynasty
Technology Advances	
Virtual Reality Machines	**Health, Psychology, and Nutrition**
Volcanoes	Brain and Hemispheres
Weather	Brain and Nervous System
	Eyes and Vision (Ophthalmology)
	Healthy Choices
	How Color Affects People (Mood)
	Nutrition and Exercise

The topic ideas show the integration and curriculum connections made by students for their survey research project. The next stage in the research process involves students finding information about their research question and topic of interest. *The Survey Toolkit* lessons provide guidelines for collecting facts (suggesting at least 15, including writing notes), avoiding plagiarism, and providing sets of bibliography cards or templates for referencing text information or electronic sources.

Extending the research component of the survey project to a final one-page, single-spaced paper with at least two reference sources has been found effective for students to gain expertise in their topic and provide the background information to write their survey. Some students during the research process will decide to modify or change their original research question based on new information learned about the topic. Prior to writing the report, students have been directed to read Chapter 1 in *The Survey Toolkit Resource Manual* to learn techniques for collecting notes, including an outline model using power notes (i.e., form of outlining) to structure writing. In addition, an example of a student's research paper notes and report is also provided in the chapter. Figure 2 shows an example of a student research report. When students are researching about their topic, they should record facts and categorize these ideas into sentences and paragraphs with reference citations to a completed typed report file (e.g., Word document). This has been helpful in providing a completed portion of the project to later add (i.e., paste) to the summary report. Students sometimes question why they need to prepare the research report, and

later realize their understanding of their topic provides valuable information and expertise on the subject prior to writing the survey.

Figure 2. A Student Research Report on Alternative Fuels

Alternative Fuels

People are realizing fossil fuels such as oil will not last forever. The answer to this is alternative fuels. Many people are uneducated on alternative fuels. They don't know what their effects are or what it is. So they continue driving past the E85 pumps, pulling into the diesel ones. They don't know diesel is slowly, breaking down our world. They don't acknowledge the fact that glaciers are melting, and our atmosphere is deteriorating, is done partly by using diesel fuel. This is damaging our earth's environment.

Ethanol is a non fossil fuel that is made from plants, and doesn't increase greenhouse effects. It is completely renewable and is biodegradable without harmful effects on the environment. Blends of ethanol and gasoline can be used in all petroleum engines without modifications. Fermenting makes ethanols, then distilling starch and sugar crops like maze, sorghum, potatoes, wheat, sugarcane, cornstalks, fruit and vegetable waste.

Ethanol reduces many emissions that harm the health of humans and the earth. Pure ethanol as well as ethanol blends reduces emissions of cancer causing benzene and butadiene by more than fifty percent. It also reduces emissions of hydrocarbons, which is a major contributor to the depletion of the ozone layer. High-level ethanol blends reduce nitrogen oxide emissions up to twenty percent. Ethanol also reduces carbon monoxide by twenty-five to thirty-five percent, which is more than any other oxygenate, according to the U.S. Environmental Protection Agency (EPA). Ethanol also reduces emissions of volatile organic compounds, as well as other harmful exhaust emissions.

Ethanol is also appealing in the business field. Ethanol production plants are good locally based industry, because it provides local jobs and markets for materials. This means that it keeps money and investment in the community. These are two reasons why farming states in the United States and provinces in Canada back ethanol fuel production.

Biodiesel is a completely renewable fuel that can be made from common waste products such as used cooking oil and/or vegetable crops. Some of the fuel sources for biodiesel are: algae farms, vegetable crops and waste conversion. Biodiesel can be produced from fat or vegetable oil, including waste cooking oil. Biodiesel is usually made from soy, palm, or canola oil and can also be made from recycled fryer oil (e.g., McDonald's or Chinese restaurants). Biodiesel has no carbon dioxide emissions, and is nearly carbon neutral, which means it, contributes almost zero emissions towards global warming.

Electricity is another versatile alternative fuel that already has a couple cars produced and in usage. Electricity can be used as a transportation fuel to power battery electric vehicles, fuel cell vehicles like hyper car vehicle and hybrid electric vehicles like the Toyota Prius, Honda Insight and Civic.

Hydrogen is yet another versatile alternative fuel. Some people say hydrogen will be the ideal fuel for cars, homes, laptops and cell phones. Hydrogen is the simplest and most abundant element in the universe and is primarily found as water, which is what humans are primarily made of. Some people also think hydrogen is the fuel of the future.

Alternative fuels including ethanol, biodiesel, electricity and hydrogen have been discussed in this report as alternatives to fossil fuels. Wind energy generated primarily by windmills and solar energy generated by solar panels are additional energy sources to also consider for the future. Every gallon of alternative fuels used is taking one-step forward, reducing environmental damage done by fossil fuels to our home, the earth.

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4.2. Developing and Administering the Survey

After completion of the information search and establishment of the research question and goals, students are ready to create their questionnaires. *The Survey Toolkit* lesson activities using teacher-facilitated discourse present techniques of effective ways to write survey questions. These techniques provide strategies, including questioning methods for defining interest in a topic, awareness of leading or biased questions, and construction of clear appropriate questions. The activity pages show types of survey questions (i.e., multiple-choice, free response, and rating scale) and guidelines for writing questions to help students develop effective and appropriate questions for their survey. Examples of other student written surveys in the resource manual

have provided additional ideas for students' reading in chapter 2. Peer review of surveys for clarity, selection of question distractors, or potential bias of items have been found to be effective strategies for development of students' questionnaires.

Students type and edit survey questions in a Word document and turn in their final draft electronic file to an online teacher folder or memory stick. The survey copy is then edited and formatted by the teacher, printed, and prepared for front and back-sided copies on a single sheet of paper for a sample size of 25. A teacher suggested number of responses equaling at least 20 is recommended to provide an adequate and manageable sample for students to learn about the characteristics of the group. Additional time may be necessary for some students for editing, including student revisions and teacher mini-conferencing about completed questionnaires. Given the limited amount of instructional time with ELP students, it would be more effective for students to pilot their questionnaire with a few selected peers and then administer the survey to a larger sample size. Examples of student written survey questions are shown in Figure 3.

Students will need to be guided in writing a variety of question types in order to produce more sophisticated graphs and findings. For example, encouraging students to write a rating scale item on their survey will broaden their data experiences working with a measurement attribute to create a graph showing statistical mean or midrange values. Free-response or open-ended questions will need to be discussed on how to report these, using *TinkerPlots*® data cards or recorded using the text box feature of the program. An activity is provided in *The Survey Toolkit* on summarizing free-response answers. An example of a student free response factual survey question on volcanoes is shown in Figure 4. Another student example includes a graph display of a factual question on planets shown in a data plot in Figure 5.

Figure 3. Student Developed Survey Questions

1. How much extra money would you spend on alternative fuels per fill-up?
   A. $ 0.00
   B. $0.01 - 2.00
   C. $2.01 - 4.00
   D. $4.01 - $6.00
   E. Other (write-in) _____

2. Colors around me affect my mood and the way I feel.

1	2	3	4	5
Not True	Not Really True	Kind of True	True	Very True

3. What do you think infrared is best used in?
   A. Night Vision
   B. Tracking
   C. Heat Detection
   D. LED's (Light Emitting Diodes)
   E. Weather Forecasting

4. If you could have any job in ancient Rome, what would you choose?
   A. Senator
   B. General
   C. Upper class official
   D. Artisan
   E. Other (write on line) _____

5. How often do you make an eye appointment?
   A. Twice a year
   B. Every year
   C. Every two years
   D. Every five years
   E. Other _____

6. What is a positron and what is its significance in an antimatter engine?
   a) It's an "anti"- electron that has a positive charge and it can be used as fuel in an antimatter engine.
   b) It's a molecule with a positive charge and it's the only solid thing that can touch antimatter.
   c) The "anti"- proton that powers an antimatter engine.
   d) None of the above.

7. About how many hours do you spend exercising in a week? (Not including P.E.)
   A. 1-2 hours
   B. 3-4 hours
   C. 5-6 hours
   D. 7-8 hours
   E. 9-10 hours
   F. Over 11 hours
   G. Other (write on line) _____

8. What kind of volcanoes are you most interested in?
   A. Cinder-Cone: blows its top, lots of ash
   B. Composite: forms land around volcano
   C. Shield: lava builds up volcano
   D. Dormant: doesn't erupt
   E. Extinct: hasn't erupted in recorded history
   F. Other (write in) _____

9. What do you want to learn about alternative fuels? _____

10. About how much time a day do you spend watching TV, going on the computer, reading books, using a cell phone texting, or playing video games?
   A. None
   B. 10-30 minutes/per day
   C. 30-60 minutes/per day
   D. 60-75 minutes/per day
   E. 75-90 minutes/per day
   F. More than 90 minutes per day

Figure 4. A Student Text Box of Free Response Answers for Students Knowledge About Volcanoes

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Do you know anything about the Ring of Fire?

A. Yes
B. No

If so, what do you know? _____

Ring of Fire full answers (unanswered/unknown/skipped):

1. Line around a plate (incorrect)
2. Area of lots of faults and volcanoes (correct)
3. Located near Pacific Ocean and has many volcanoes (correct)
4. Point of volcanoes (incorrect)
5. Full Name: Pacific Ring of Fire (correct)
6. A volcano (incorrect)
7. Volcanoes are there (correct)
8. Lots of volcanoes are there (correct)
9. Area around Pacific plate with lots of volcanic activity (accurate)
10. Volcanoes in a circle (correct)
11. Belt of volcanoes (accurate)

Figure 5. Student Graphs From a Factual Question on Planets and Free Response Question on Inventions

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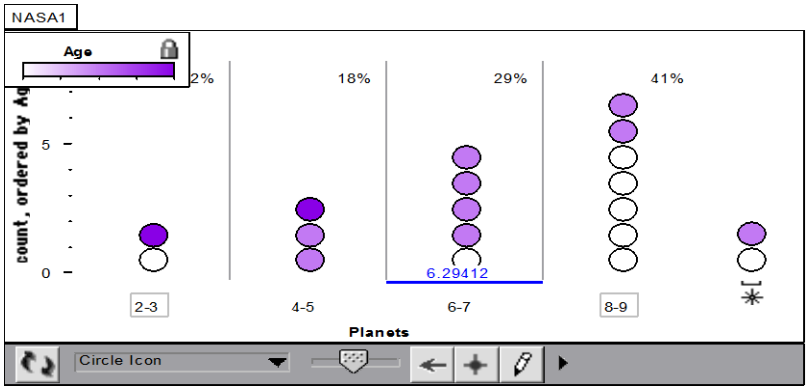

Planets: How many planets in our solar system could they name (the numbers represent how many they could name)?

Movfloors: If moving floors are useful? (Would moving floors be helpful if invented for transport in buildings?)
Movfloorswhy: Why are they useful? (What purposes is provided by moving floors.)

After students complete their survey, they will need to select an appropriate sample from a population to administer their questionnaire. Lesson activities about types of sampling procedures, calculating response rate, and generalizing results to the population are presented in *The Survey Toolkit*. Different types of sampling techniques (e.g., random, cluster, volunteer, judgment, and systematic) are discussed and evaluated by students in *The Survey Toolkit*. *The Survey Toolkit Resource Manual* chapter 3 on selecting a sample from a population provides information on different sampling techniques, supporting ideas presented in the lesson. Students have been found to use convenience or volunteer sampling (e.g., classroom or lunchroom) to administer their survey due to limited amounts of time available during the unit of instruction. A few students who use other inferential sampling procedures have been able to generalize their findings to the population (e.g., sixth grade students in the middle school). Using teacher scaffolding and student discussion *The Survey Toolkit* provides activity discussion points about sampling and selecting samples, which may better represent the population. For the purpose of the survey project students will focus findings on a sample to learn what their group is about, with the aim not to infer.

The Survey Toolkit provides guidelines for writing hypotheses, and students have been able to effectively select and write hypotheses from two survey questions for their project. *The Survey Toolkit Resource Manual* chapter 4 on research hypotheses, which has been assigned as a reading, presents guidelines for writing hypotheses, student examples, and evaluating outcomes.

Students can readily select two questions from their survey and write hypotheses after completion of lesson practice activities. The lesson practice and guidelines emphasize writing a hypothesis to describe the sample of students and not an individual surveyed. The teacher will need to pose additional questions if the researcher hypotheses can be generalized to the population of students sampled. Students with a convenient or volunteer sample will only be able to write predictions about their sample group, and not evaluate hypotheses for making inferences to the population. Figure 6 shows examples of student written hypotheses and reported findings.

Figure 6. Student Hypotheses and Findings Reported From Selected Survey Questions

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• The majority of the sample will report California, Texas, or Arizona as the state that uses the most solar energy. I accept the hypothesis because the graph shows 63% of the sample choosing California, Texas, or Arizona as the state that uses the most solar energy.
• Students will have a favorable attitude toward saying that the Roman government had an important effect on modern democracy. I accept the hypotheses because graph 2 shows that on a rating sale of 1 to 5 the average was 3 1/3.
• Over half of the students will have a visual impairment, such as glasses, contacts, or had surgery. I reject this hypothesis because only a few students (n= 7) did have a visual impairment.
• My first hypothesis was that the majority of the students would suggest that the Earth is running out of resources. My hypothesis is correct because 95% of the kids said somewhat to absolutely.
• The majority of the people will report the best way to get out of the solar system is by antimatter engines. I reject the hypothesis because the majority of the people reported the best way to get out of the solar system is by conventional rockets.
• A majority of students who report eating lots of junk foods, will choose salty foods as the types of the foods eaten. I accept my hypothesis because 60% of the students who eat lots of junk foods chose salty as being eaten. (Graph 9)
• Significant differences will be found in students selecting a certain color as lucky. I accept this hypothesis because 12 people thought a certain color was not lucky, and six people thought of a color as lucky.
• Students will report no significant differences in their opinions on various fuel sources. My findings reject my hypothesis because the majority of the participants answered a variety of fuels (graph 9).
• The majority of the students will report the Greek Gods help in life. I reject my hypothesis because the majority of the students said the Gods somewhat help life in Greece.
• Students will have an unfavorable opinion in being interested in learning about the eye. I accept my second hypothesis because the mode of 1.6 indicated low interest in learning about the eye.

Survey guidelines and administration procedures are presented in *The Survey Toolkit*. The lesson plan activities include discussion of anonymity and privacy, along with instructional handouts (e.g., dialogue script) preparing students to successfully administer their surveys to their selected sample. It has been useful to copy and paste instructions provided on the student activity page at the top of the final student survey draft prior to having copies made. The instructions discuss privacy and anonymity and the option for students to "X-out" or opt out from taking the survey if they feel uncomfortable or desire not to participate. Students who report having a high number of students opting out from their survey typically need to give their survey to another sample. Students should provide possible reasons for respondents opting out when writing their final report recommendations. As a practice it is recommended that students notify building administrators and staff of survey research being conducted, and seek permission if required, especially for some survey topics of study (e.g., healthy choices).

4.3. Analyzing Survey Data

The Survey Toolkit provides examples and lesson discussion on using the TinkerPlots® program and creating different types of graphs along with guidelines for entering completed surveys as attributes on the data cards. Data cards list the attributes students assign to each survey question with each card representing one survey case of entered survey question responses. In addition,

information is provided on summarizing free-response answers and evaluating the sample response rate. Following the lesson procedures and activities, including teacher directed demonstrations using *TinkerPlots*®, students have been able to independently create data cards and plots (i.e., categorical and measurement attribute graphs) based on their survey results.

Before students enter survey cases using *TinkerPlots*® data cards, they will need to number each survey and write an attribute name for each survey question item. Additional teacher directed procedures to support students in their data analysis include:

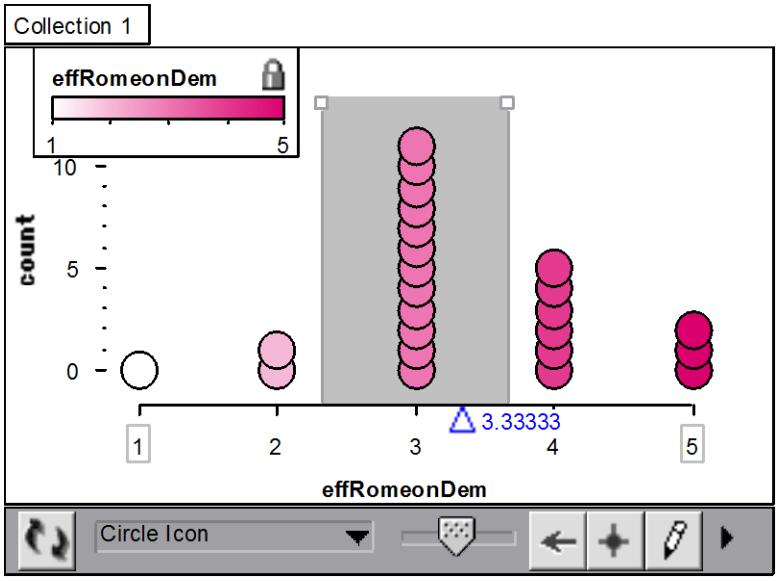
- Assigning value names to answer choices when possible (e.g., yes/no, select key words, or paraphrase in words) so these appear on their plots rather than letter choices (i.e., A, B, or C answers).
- Encouraging students to enter free response questions' answers in the data cards when values can be made into short responses and grouped together.
- Suggesting use of text boxes when free response questions are difficult to group and survey answers are varied.
- Displaying the *TinkerPlots*® case table after data cards are completed to check for inconsistencies (i.e., spelling, capitalization, formatting) or inappropriate handling of absent or incomplete survey answers.
- Reminding students they can edit and correct values directly on the case table, which will be changed on their stack of data cards.
- Encouraging students to frequently save their *TinkerPlots*® file and create a back-up copy, preventing students from accidentally erasing data cards with one keystroke of the delete or backspace key.

These procedures will help students to successfully create graphs and find answers to their research question and hypotheses based on their survey sample selected from a population.

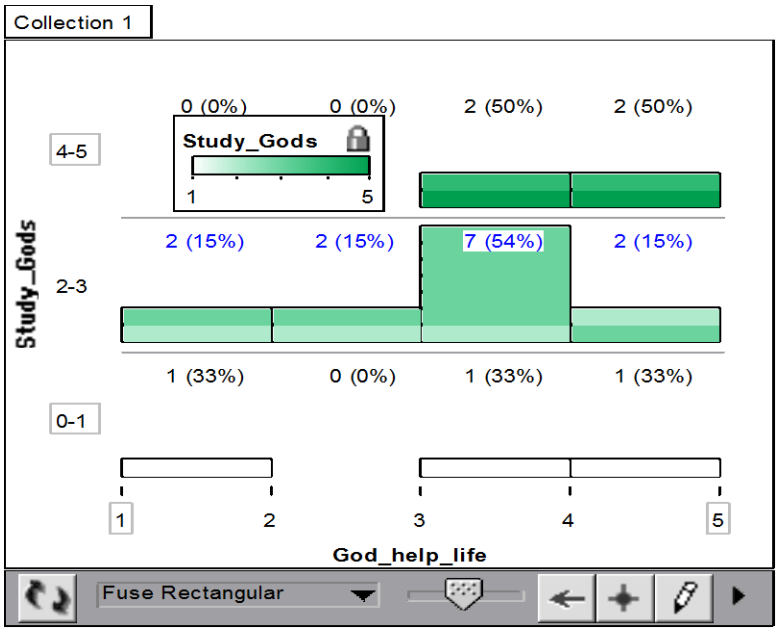
Several lessons in *The Survey Toolkit* on entering data into *TinkerPlots*® are provided on the tool features of the program for creating different types of graphs, discussing statistics terminology (e.g., mode, averages, outliers) and including student activity pages to evaluate graph development. The activity pages guide students in creating a variety of graph types using categorical, quantitative (numerical or measurement), and comparative attributes. It has been found effective to provide examples on how to create different types of graphs using the New Zealand Data and Demos file included with the *TinkerPlots*® program. It is important for students to understand the difference between categorical and quantitative attributes when developing different graph types (e.g., only quantitative attributes will display statistical mean values), and creating graph displays that are informative and relevant to their research question and hypotheses. While creating plots teachers will need to provide scaffolding by asking guiding questions for students to decide if their graphs provide meaningful research information. Additional informational reading discussing the differences between categorical and quantitative attributes, along with some background information about statistics terminology, is provided in chapter 5 of *The Survey Toolkit Resource Manual*.

The Survey Toolkit and resource manual (chapter 6) present information on creating hat and box plot graphs that show the spread or variability of data. Some students who may need some additional challenging differentiation may benefit from learning about these statistical concepts and creating these types of graphs. Some examples of student graphed survey data displays are shown in Figure 7 and 8. Prior to printing the *TinkerPlots*® graphs, students should show page breaks and organize their plots including display of text boxes and a text box dictionary to describe what each attribute means.

Figure 7. A Sample of Student TinkerPlot Rome and Greek Research Graph Displays, Including Attribute Descriptions with Reported Findings

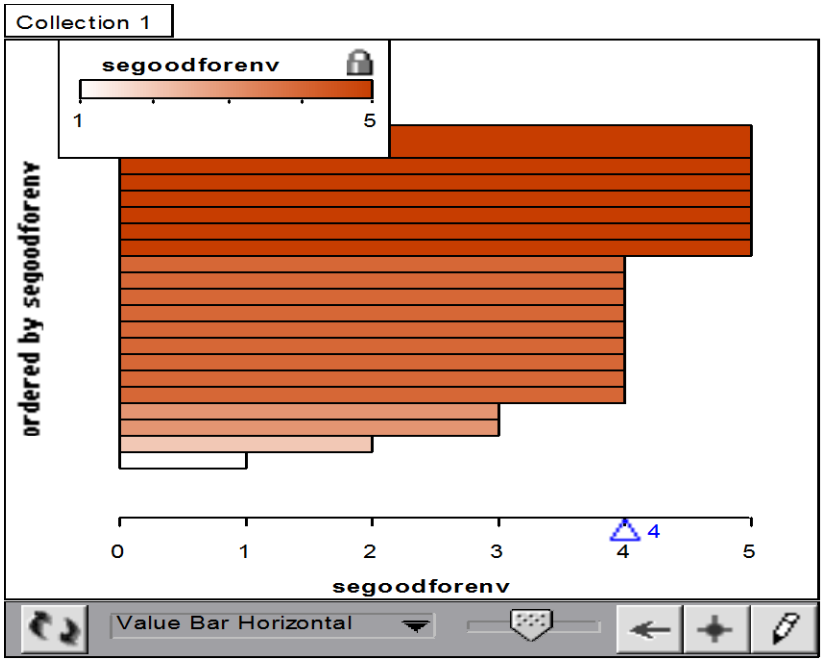


effRomeonDem: Effect that Rome had on modern democracy 1-5 1=not important 5= very important
Students will report that the Roman government had an important effect on modern democracy. I accept the hypotheses because graph 2 shows that on a rating sale of 1 to 5 the average was 3 1/3 showing a moderate effect.

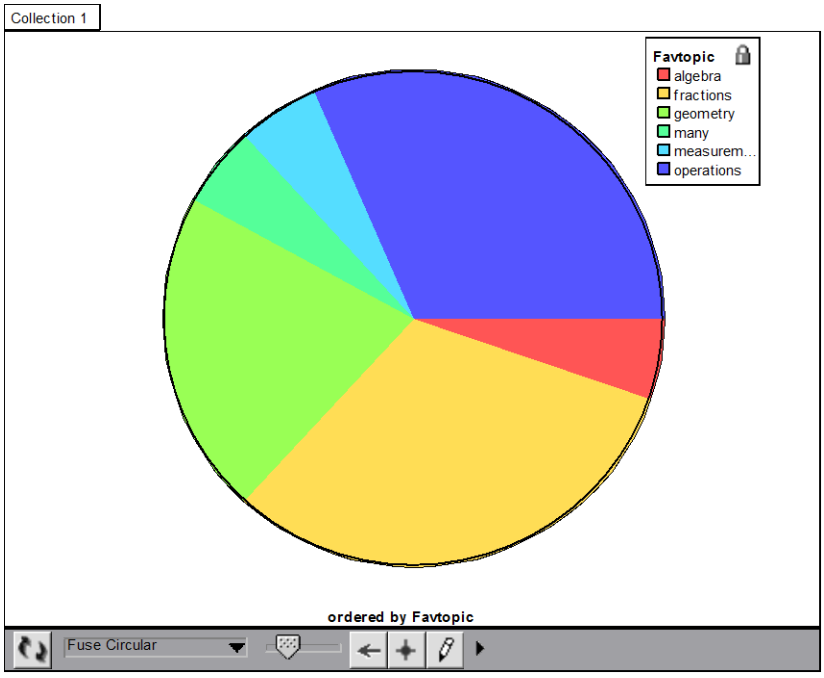


Study_Gods: Do you think Greek Gods are important to study in school?
God_help_life: Do you think the gods helped the Greeks live a better life?
When comparing if God helps life and how much a student knows about Gods, students who study more about the topic think that the Gods helped in life in ancient Greece.

Figure 8. A Sample of Student TinkerPlot Energy and Math Research Graph Displays, Including Attribute Descriptions with Reported Findings



segoodforenv: Solar energy is good for environment (scale1-5)
The majority of the sample will report solar energy is good for the environment (4 or 5). I accept the hypothesis because only 20% chose 1, 2, or 3 and 80% of the sample selected 4 or 5.



Favtopic: Which of the provided topics do you like the most?
The study also found that most students prefer fractions and operations as their favorite math topic (graph 3).

4.4. Sharing Results

In the last part of the research project students summarize the findings based on their constructed graphs and displayed data. *The Survey Toolkit* provides activity pages for writing findings and conclusions and forms for summarizing the research results. Selection of the short or longer form A or B will depend on the level of the students and the amount of available time they have to complete the summary report. Students sometimes have difficulty with this final phase of the project because of their lack of experience in writing findings and reporting results. They may need individual assistance and support in completing the summary research report. It is helpful for students to see examples of effectively written hypothesis findings, like those given in Figure 6. In addition, students need to be provided a variety of writing strategies for reporting findings from graphs, similar to those provided in Figures 7 and 8. Summarizing information when writing conclusions and making recommendations based on concluding ideas from the research question will require teaching question scaffolding (e.g., How will your research information be used or be helpful for others? Would you repeat the project again with a different research question and survey?) A student copy of a research summary, like the one provided in the Figure 9 report on Greece, is helpful for students to review. *The Survey Toolkit Resource Manual* chapter 7 provides guidelines and examples for writing a summary report. A rubric evaluation form is provided in *The Survey Toolkit*, which can be used by the teacher and/or peers to provide feedback on the completed research project. *The Survey Toolkit Resource Manual* includes a peer review log in the appendix resources section (yellow forms shown in Figure 10) where students can record comments about the poster paper display presentations.

Figure 9. A Student Summary Report on Greece Today and Yesterday

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Research Summary

My research question was if Greece sounded interesting for people to study. The goal of my research was to find out about Greece and who was interested in it.

My sample was of my homeroom class; I chose that because of its convenience. The population my conclusions apply to is the sixth grade M team. My sampling method was to choose one of the M team classes or my homeroom. A possible source of bias was on the survey question about the favorite Goddess or God because of the amount of information given for each one. The response rate of my sample was 100%, meaning that 100% of the people who were given the survey responded.

The survey asks about people's interests in Greek Gods and Goddesses, Olympics, government, and climate. I collected this information off of the Internet.

My first hypothesis was that there would be no significant difference in whether people want to travel to Greece or not. I reject this hypothesis because many more people prefer to travel to Greece. My second hypothesis was that most males would select Zeus or Hades as opposed to most females who would select Apollo or Poseidon as the Goddess or God they are most interested in. I reject this hypothesis because most males selected Poseidon instead of Zeus or Hades, and females selected a wide variety of different ones.

I found that most students would rather race than fight (graph number 1). Graph number 2 shows that few people chose the Acropolis as the landmark in Greece they would like to go to. I found that the god most people were interested in was Poseidon (graph 3). In graph 5, I found no significant difference in what currency people thought belonged to Greece. A majority of people were somewhat interested in Greek Gods and Goddesses (graph 7). Most people (n=11) thought that Greece received a normal amount of rain (graph 8). Fourteen people thought that Piraeus was not the capital of Greece (graph 9). A majority of the people's first interest was to study Greek mythology (graph 10). No significant differences were found in whether people thought there were a certain number of seats in the Greek legislature.

If the study were to be repeated, I would include some people from every class on the M team, since some classes may have studied Greece and some may not have. I would change my hypothesis to one about Olympic sports.

I now conclude that some people knew quite a bit about Greece, and appear to have some amount of interest in the topic. Some people on the other hand know less about Greece and show little interest in studying Greece. Some people are just in between. So, there really isn't a significant difference in whether they are interested in Greece or not.

A recommendation would be to try surveying more people. I would make copies of the report I wrote and pass it out to those who took my survey so they can compare what they said to what's on the report.

I learned much about the Greek Gods and Goddesses, about the Greek culture and about Greek government. I found out that many people were somewhat interested in Greece. I learned a lot about Greek culture and life.

Figure 10. View of Grade 6 Poster Board Projects with Peer Review Logs

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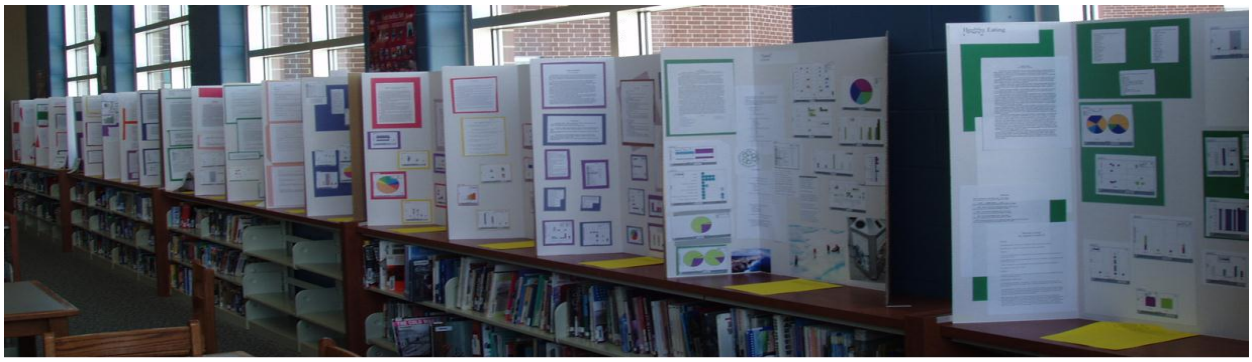

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5. Evaluation of Student Learning

A five point rubric evaluation is provided in *The Survey Toolkit* for teacher and/or student feedback on the final research project. The rubric has been used to evaluate student poster projects for background research, survey question development, report findings, graph analysis,

language usage, layout, and technology use. The five-point rubric evaluation has provided evidence that most students successfully master numerous learning skills. Based on survey research products displayed from the poster boards, students have acquired all or most of these skills and competencies after completing the project:

- Learning procedures and steps in conducting survey research
- Developing the research question and writing a goal statement
- Locating information about their research question, taking notes, summarizing information, and writing reference citations
- Recognizing bias information and strategies to avoid plagiarism
- Learning guidelines (e.g., confidentiality) and strategies to write survey questions
- Learning about sample and population characteristics
- Developing understanding of the effects of sample size and response rate on research findings
- Recognizing bias effects caused by sampling procedures and survey question item development
- Understanding differences in types of sampling procedures and which would generalize to the population
- Using critical thinking to write research hypotheses about survey questions
- Learning survey administration procedures and confidentiality issues
- Interacting with a technology database tool program using authentic data
- Deciding which variables (i.e., category and measurement attributes) are the most appropriate for creating informative data plots
- Reading and interpreting data plots (graphs) for meaningful information
- Evaluating data and attribute plots to write research findings about a research question
- Summarizing information to write conclusions and evaluating the research project for reporting recommendations
- Sharing their project by creating a poster paper display of report information and graph displays
- Orally sharing survey research findings to the survey sample or appropriate audience.

The rubric and poster board project display of authentic student survey data provides preliminary evidence of the skills required to complete the research project. Additional preliminary evidence of student learning of skills has been shown based on pilot testing using an assessment for survey research during the six years of implementation of the curriculum. The post-test was given to ELP students at the end of the project and included multiple-choice items about survey concepts, and a problem evaluating a student's data set attribute on alternative energy. The assessment and answer key is provided in *The Survey Toolkit Resource Manual* in the appendix resources.

6. Further Research and Recommendations

The introduction of a middle school survey research project and statistics program using *The Survey Toolkit* and *TinkerPlots*® will need to be studied and evaluated beyond its current use. Methodology concerns for teachers, including understanding of content knowledge and concepts, responding to students' solutions and interpretations, and evaluating attitudes and beliefs about teaching statistics using data analysis will need to be investigated. Burrill's (2007) National Science Foundation (NSF) project study substantiates the need for research on the teaching of statistics stressing reasoning with data and using available sophisticated technology tools. Burrill reports that middle school students making and interpreting box plots with software tools may not benefit students' cognitive complexity and may cause rote use of the procedural applications.

Despite the broadening widespread use and support from professional organizations for the teaching of statistics, teachers have either lacked an effective program or faced implementation concerns in the delivery of a statistics curriculum. The Hawkins, Jolliffe and Glickman (1992) survey of UK teachers reports most respondents enjoyed teaching probability and statistics but found that a scientific methodology was needed when data are evaluated and processed. Teachers' poor understanding of the basic content of concepts and ideas about statistics, as well as methodology issues is problematic for teachers (Garfield & Ahlgren, 1988; Russell, 1990; Hawkins et al., 1992). Teachers feel uncomfortable teaching statistics concepts because they have not been adequately trained, and many of the teachers have either never taken a formal statistics course or had very little formal training (Begg & Edwards, 1999; Franklin, 2000). Research indicates that professional development activities are probably the most important resource for teachers to improve meaningful knowledge of content and attitudes toward mathematics (Battista, 1986; Ball, 1991; Hill & Ball, 2004; Quinn, 1997). Schoen, Cebulla, Finn, and Fi (2003) found similar results and that completion of a professional development math workshop course were positively related to growth in student achievement. Hall (2009) describes a teacher hands-on exploration workshop using *TinkerPlots* where participants used real data about their pupils that resulted in positive attitudes toward teaching statistics. It is the intent of the author to use *The Survey Toolkit Resource Manual* as an in-service model or plan to provide staff development for teachers. Included in the manual is a proposed staff development syllabus using *The Survey Toolkit* with *TinkerPlots*® program. The support materials provided by the resource manual will need to be evaluated and reviewed for their usability. Research will need to be conducted about the overall effectiveness of the proposed in-service plan in developing teacher understanding of statistical concepts, providing a usable methodology for survey instruction, and evaluating implementation and use of the curriculum with students.

An evaluation of student learning and skills acquired from this instructional research curriculum will need to be studied beyond use of rubrics and peer reviews based on student completed poster board projects. A post-test was given to students to assess their knowledge and skills, vocabulary, concepts, and understanding of survey research and statistical data. A revised post-test will need to be given and include an item analysis to more effectively evaluate the specific learning skills of the students. The assessment will need to be administered as a pre- and post test to evaluate student learning and competencies acquired from the research project. When testing younger grade students, alternative evaluation instruments or a test item selection database will be needed to evaluate student learning when teachers provide instruction during a shortened period of time, or focus on a narrower use of the program materials. In a younger elementary classroom students could create a classroom survey and data cards followed by student group exploration in creating graphs and reporting findings. Evaluation of student reasoning and ability to overcome some statistical learning obstacles using *The Survey Toolkit* curriculum will need to be explored.

Shaughnessy's (2007) discussion on students' statistical learning reports the following issues frequently cited in the literature and summarized as follows:

- Developing higher-level conceptions of average or mean to a point where it is representative of a data set.
- Learning to recognize and investigate potential sources of variation within the data and not only focus on looking at centers.
- Moving from focusing on particular data points or individual features of the data, rather than

comparing and evaluating the sample distributions.
- Developing intuition for a reasonable amount of variation around particular values, including extremes or outliers involving the spread of an entire data set or distribution.
- Helping develop awareness of potential sources of bias in sampling.
- Supporting reading and interpreting of particular types of graphs, and to reason beyond graphs.

Shaughnessy reports beliefs and conceptions about data and chance are difficult to change. To gain expertise in statistical reasoning students will need to become practicing statisticians investigating statistical problems that interest them, collecting data, analyzing it, and drawing conclusions. Use of *The Survey Toolkit* curriculum with students as practicing statisticians, collecting and evaluating authentic data, will need to be evaluated.

What students learn about statistics or how their statistical thinking develops while using technology tools is limited compared to the research in other areas of statistics education (Shaughnessy 2007). Konold et al.'s (2004) analysis of learning identified four general perspectives that students use when interpreting tool technology data as pointers, case values, classifiers and as an aggregate. Konold found some students are inclined to view data from one particular perspective which influences, and perhaps constrains, the types of questions they ask, the plots they generate or prefer, the interpretations they give to notions such as the average, and the conclusions they draw from the data. Research and evaluation of how students learn with tool technologies like *TinkerPlots*® is emerging in the literature. Ben-Zvi (2006) describes use of *TinkerPlots*® with teacher scaffolding involving students collecting data about themselves and peer students compared to a UK Census at School database. Ben-Zvi found, based on pre-post tests, significant improvements in students' understanding of informal inference and developing knowledge of statistical ideas. Khairiree and Kurusatian (2009) also reported finding *TinkerPlots*®, if appropriately employed as a problem-based learning tool, can be effective in enhancing active learning and students' understanding of statistics. Further research on student learning with *TinkerPlots*® will be needed, including the use of other adaptable software programs that may be effective with *The Survey Toolkit* curriculum.

The effects of providing probability and data activity experiences to students prior to with *The Survey Toolkit* statistics project will need to be studied. Support for teaching both probability and statistics has been given in general terms as follows:
- Garfield and Ahlgren (1988) suggest the use of the term "stochastics" to highlight the integration of probability and statistics.
- Shaughnessy (1992) reports that stochastics is the common European term to include "probability and statistics."

The effects of teaching a more structured "stochastics" unit (i.e., the teaching of statistics and probability), as this author does in his classroom, will need to be investigated. Providing more focused opportunities to explore concepts prior to use of "landscape-type" curriculum with technology tools that put students in very open situations, with a variety of powerful choices, including sorting and arranging data into a variety of visual display formats has been recommended (Bakker, 2002). Bakker describes TinkerPlots, resembling the landscape metaphor, as a construction tool offering students many possibilities for creating plots by separating, stacking, ordering, fusing, and changing icons (i.e., data dots) into different types of graphs (e.g., bar, histogram, or pie). The author has provided approximately 30 45-minute periods (i.e., six weeks) of instructional time for the research poster project with his sixth grade ELP students. Implementation of the program during shorter or longer time periods and the effects on student learning will also need to be studied. Implementation of the curriculum over a

longer period of time or integrated with the teaching of probability could provide students greater time to administer surveys using inferential sampling techniques (e.g., systematic, stratified, or random) in order to generalize findings to the population. Given longer instructional time periods would provide students opportunity to survey more than one sample, or create a collaborative survey with another peer resulting in construction of similar plots to compare findings from two convenient or volunteer samples. *The Survey Toolkit* curriculum was developed with the assumption students have limited, if any, background knowledge in data analysis. Research addressing the effects of prior knowledge, like a "stochastics" probability unit and implementation of this curriculum will be necessary.

7. Conclusion

The Survey Toolkit has been found to be applicable for researching topics across the sixth grade curriculum. Students have experienced the process of doing research by gathering information (i.e., from books or web resources), developing paragraph writing skills, using scientific inquiry (e.g., writing hypothesis), calculating mathematical statistics by creating graphs using *TinkerPlots*®, and sharing poster boards. The text materials and use of *TinkerPlots*® also provide technology integration for developing skills in data representation, constructing comparison graphs, and applying tools (e.g., statistics buttons like mean or mode) to interpret survey findings. Topics for this research approach in learning can cover any content or curriculum area or be integrated into an existing unit of study. Students have been successful in developing research questions based on a list of topics related to the sixth grade curriculum. *The Survey Toolkit* not only supports the NCTM math standards but also promotes language arts skills identified by the International Reading Association and National Council of Teachers of English (1996) in the Standards for the English Language Arts. The language arts component is particularly evident in the research process students learn from developing research questions, researching information, writing a survey, and reporting findings with conclusions and recommendations.

The Survey Toolkit has been discussed as survey research curriculum used by the author's sixth grade students. The report describes how to effectively use *The Survey Toolkit* curriculum and *TinkerPlots*® software to provide instruction to students in learning about survey and statistics. The article has discussed implementation of the curriculum, teaching methodology considerations, as well as effective student learning strategies, and presented examples of student work. Preliminary anecdotal and rubric information about student learning was provided. Research supporting the teaching of statistics and an introduction to the development and organization of *The Survey Toolkit* were discussed. The need for further research to evaluate the effectiveness of the curriculum materials, student learning, alternative teaching strategies, use of *TinkerPlots*®, and staff development was provided. Evaluation of *The Survey Toolkit* curriculum will be needed to improve students' ability to think statistically, since statistics and statistical reasoning are becoming part of the mainstream school curriculum in many countries (Garfield and Ben-Zvi, 2007).

Author Background

Thomas Walsh PhD has been an elementary and middle school teacher for over 30 years. He also has provided ESL teaching at the elementary and adult level in Costa Rica, Chile, and Tanzania and technology instruction at Iowa State University. Survey experiences have been provided to his third and sixth grade students at the elementary and middle school. His authored text *The Survey Toolkit Collecting Information, Analyzing Data and Writing Reports* (Walsh, 2009a), referred to as *The Survey Toolkit* in the research paper, is currently used with his sixth grade middle school ELP students with the *TinkerPlots Dynamic Data Exploration* (Konold, 2005) software program. The text and software program are available from Key Curriculum Press at http://www.keypress.com/. *The Survey Toolkit Resource Manual* is used in his current classes to support student learning and provide staff development training. A literature review supporting the development of *The Survey Toolkit* curriculum is available for download at http://walshsurveytoolkit.pbworks.com/w/page/32611904/FrontPage (Walsh 2011).

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